421774

FLOOD INSURANCE STUDY

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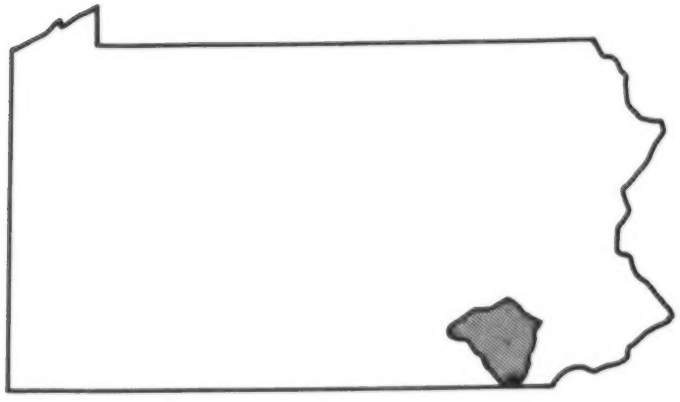
TOWNSHIP OF FULTON, PENNSYLVANIA
LANCASTER COUNTY



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PUBLISHED SEPARATELY:

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWNSHIP OF FULTON, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Fulton, Lancaster County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Fulton to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses used for this study were prepared by Huth Engineers, Inc., for the Federal Insurance Administration, under Contract No. H-4760. This work was completed in November 1979. The hydrologic and hydraulic analyses for the Susquehanna River were previously performed by the Susquehanna River Basin Commission.

1.3 Coordination

The initial Consultation and Coordination Officer's (CCO) meeting was held in May 1978, and was attended by representatives of the FIA, the Township of Fulton, and the study contractor, Huth Engineers, Inc. The meeting was intended to explain the nature and purpose of the Flood Insurance Study and to determine which streams would be studied by detailed methods.

A notice announcing the beginning of the study and stating its objectives was placed in the local newspaper and a letter was sent to community officials requesting information.

Contact was also made during the course of the study with the U. S. Department of Agriculture, Soil Conservation Service (SCS); the U. S. Department of the Army, Corps of Engineers (COE); the U. S. Department of the Interior, Geological Survey (USGS); the Commonwealth of Pennsylvania, Department of Environmental Resources (DER); the Susquehanna River Basin Commission (SRBC); and the Lancaster County Planning Commission, seeking information for the study.

On May 13, 1980, the results of this study were reviewed at the final CCO meeting attended by representatives of the study contractor, the FIA, and township officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Fulton, Lancaster County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

Flooding along the Susquehanna River, through the Township of Fulton, was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known hazard areas and areas of projected development and proposed construction for the next five years, through November 1984.

Peters Creek, Puddle Duck Creek, Conowingo Creek, Little Conowingo Creek, Octoraro Creek, Haines Branch, and numerous unnamed tributaries were studied by approximate methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Township of Fulton is located in southern Lancaster County, in southeastern Pennsylvania. It is bounded on the northwest by the Township of Drumore, on the north by the Township of East Drumore, and on the east by the Township of Little Britain. A small portion of Fulton's southeast border is bounded by the Township of West

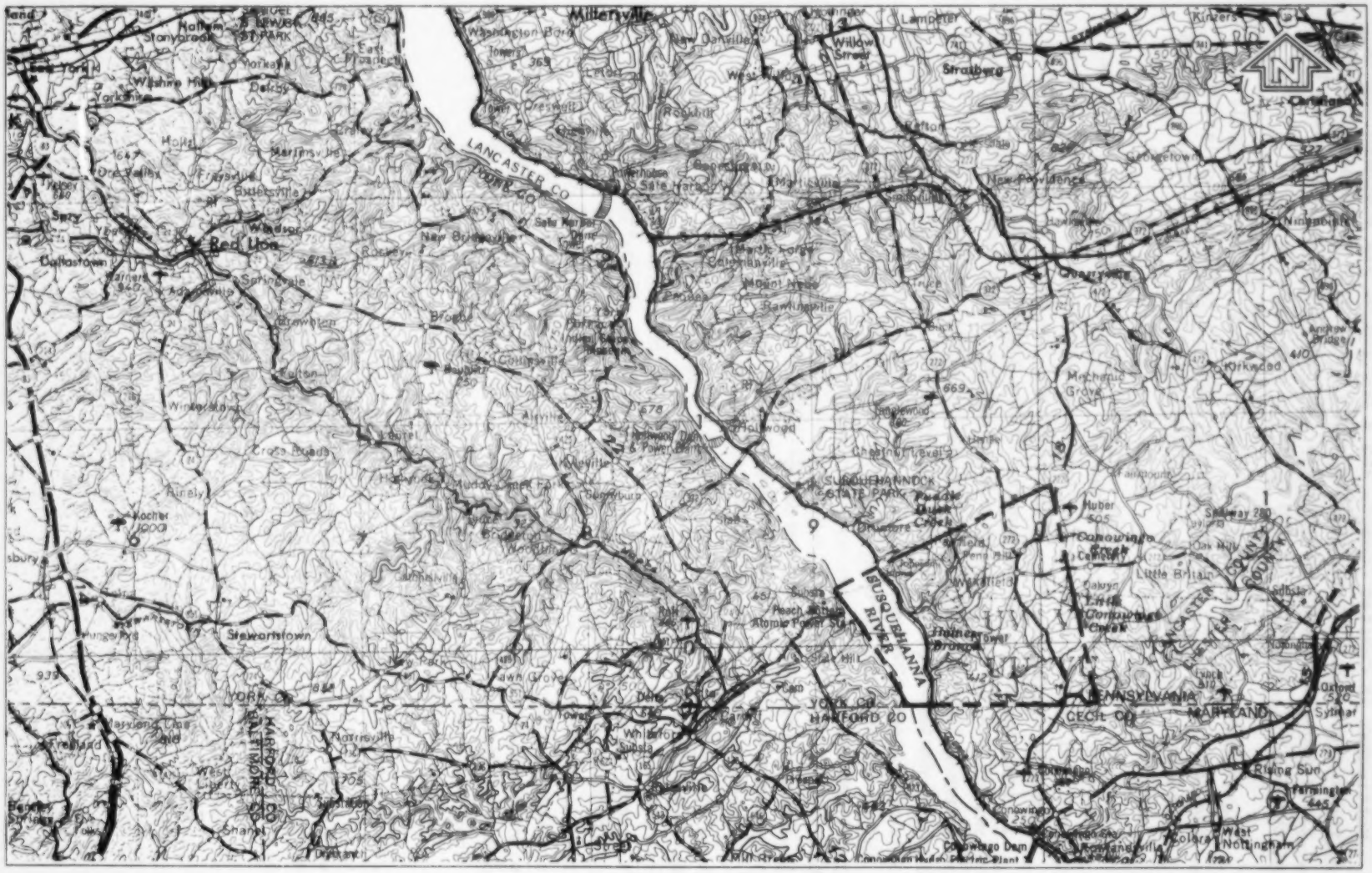


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF FULTON, PA
(LANCASTER CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Nottingham in Chester County, and a portion of its southern border forms the Maryland-Pennsylvania state line. The Susquehanna River flows along the southwest border. The nearest major community is the City of Lancaster to the north.

The 1970 Census registered a population of 1,793 (Reference 1). The Commonwealth of Pennsylvania projects a township population increase to 1,961 by 1980 providing for a 0.9-percent annual growth rate (Reference 2).

The general climate of southeastern Pennsylvania is classified as modified humid continental. Precipitation levels average 41 inches annually (Reference 3). Thunderstorms, the major form of precipitation, occur during the months of May through September. These storms are localized in character and may cause localized flooding. Major regional floods are usually the result of either large tropical disturbances, such as hurricanes, or combined events, when heavy rains occur during a period of snowmelt. The average snowfall for the region is 30 inches; any snow cover usually melts during March and April.

Fulton encompasses an area of 25.4 square miles, and is rural in character. Productive agricultural land is located on rolling terrain. Land elevations range from 110 to 520 feet.

Storm water drainage in the township is conveyed by Peters, Puddle Duck, Little Conowingo, Conowingo, and Octoraro Creeks, Haines Branch, and the Susquehanna River. Peters Creek and Haines Branch, both tributaries to the Susquehanna River, drain the area west of Pilottown Road, and flow west. Conowingo and Little Conowingo Creeks drain the area between Pilottown Road and Pennsylvania State Route 272 and flow south. Octoraro Creek drains the area east of Pennsylvania State Route 272 and also flows south. The Susquehanna River's west bank forms the western township boundary and the river flows south.

2.3 Principal Flood Problems

Based on historic data and information resulting from this study, the Susquehanna River is the principal source of flooding problems in the Township of Fulton. In 1972, Tropical Storm Agnes caused major flooding on the river, estimated to have a recurrence interval of 100 years. This information is based on data from the USGS gage at Marietta, which is north of Columbia and approximately 27 miles upstream of the township.

2.4 Flood Protection Measures

There are no present or planned structural flood protection measures employed within the Township of Fulton. Existing hydroelectric dams at Holtwood and Conewago on the Susquehanna River do not have flood control design capacity.

Non-structural measures in the form of zoning ordinances are utilized in the township for preventing future flood damage by restricting construction in flood prone areas. The delineation of flood plain areas was based on the location of alluvial soils as determined by the SCS.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

The Water Resources Council has recommended the log-Pearson Type III Method for determination of discharge relationships (Reference 4). For gaged sites, flood-frequency data can be obtained directly from statistical analyses of flood peak discharge data. For ungaged sites, it is necessary to regionalize the flood-frequency data for two or more sites.

The log-Pearson Type III method requires the mean (M), the standard deviation (S), and the skew equation:

$$M = Cm + 0.75 \log (A)$$
$$S = Cs - 0.05 \log (A)$$

where A is the drainage area in square miles. Cm and Cs, which are coefficients and the skew (g) coefficient were obtained from maps (Reference 4). The SRBC has recently made some modifications to the Cm and skew coefficient maps used in this study.

For the Susquehanna River, the statistical analyses were performed by the COE for stream gages at Harrisburg and Sunbury (Reference 5). The stream gage at Harrisburg is located approximately 52 miles upstream from the northern boundary of Fulton and has been active for 82 years. The stream gage at Sunbury is located approximately 104 miles upstream from the northern boundary of Fulton and has 54 years of record. This statistical analysis followed the standard log-Pearson Type III Method. The flood-frequency curves were adjusted for the effects of upstream reservoirs.

For the Township of Fulton, an ungaged site, values of the 10-, 50-, 100-, and 500-year floods at the above stream gaging stations were plotted against area on logarithmic coordinates. The appropriate values for the study area were then extrapolated from the plot.

A summary of drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SUSQUEHANNA RIVER					
Southern end of Hennery Island	26,880	445,000	670,000	700,000	1,170,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Hydraulic characteristics of the Susquehanna River within the township are controlled by the Conowingo Dam. The backwater from the dam extends through the entire length of Fulton into the Township of Drumore. Therefore, no step-backwater computer model was developed for this area. Consequently, no cross-section data was obtained within Fulton.

Flood profiles were drawn showing the water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. These profiles were obtained from a rating curve for the Conowingo Dam. Profiles were determined for the 10-, 50-, 100-, and 500-year floods. Comparison of the Susquehanna River profiles were made with high-water marks from the Tropical Storm Agnes flood of June 1972. The results were in good agreement. Differences between the elevations of the various flood recurrence intervals remain constant throughout the entire length of the Susquehanna River through the township.

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using topographic maps of the study area at a scale of 1:2,400, with a contour interval of 5 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The approximate flood plain locations are based on the Flood Hazard Boundary Map for the Township of Fulton published in July 1976 (Reference 7).

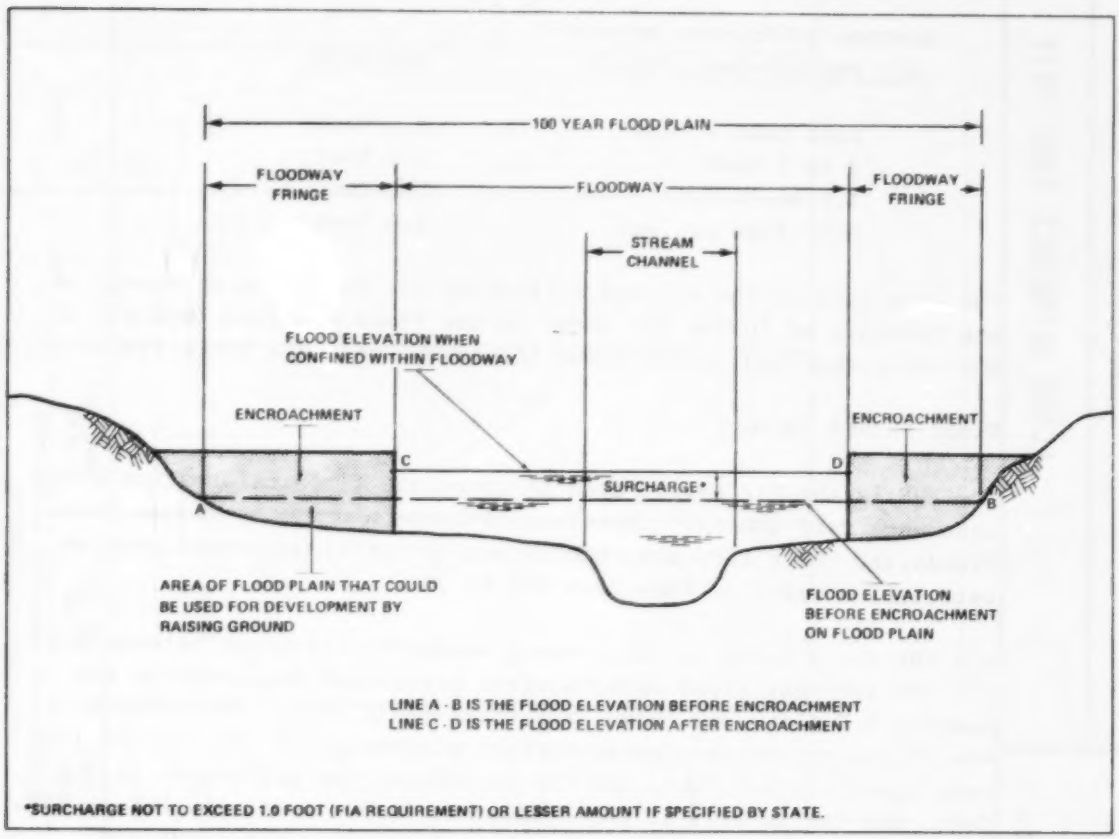
The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway in this area is coincident with the channel banks. Any encroachment to the channel banks will result in a surcharge less than the 1.0 foot maximum.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Township of Fulton.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Township of Fulton are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 2).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Fulton was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Susquehanna River Reach 1	10	-1.0	-0.6	+6.2	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF FULTON, PA
(LANCASTER CO.)

FLOOD INSURANCE ZONE DATA

SUSQUEHANNA RIVER

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone A2:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 2, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Fulton is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies are currently being prepared for the Townships of Drumore, East Drumore, and Little Britain (References 8, 9, and 10). When completed, the results of those studies will be in agreement with the results of this study. No other studies were found to exist at the time of this report.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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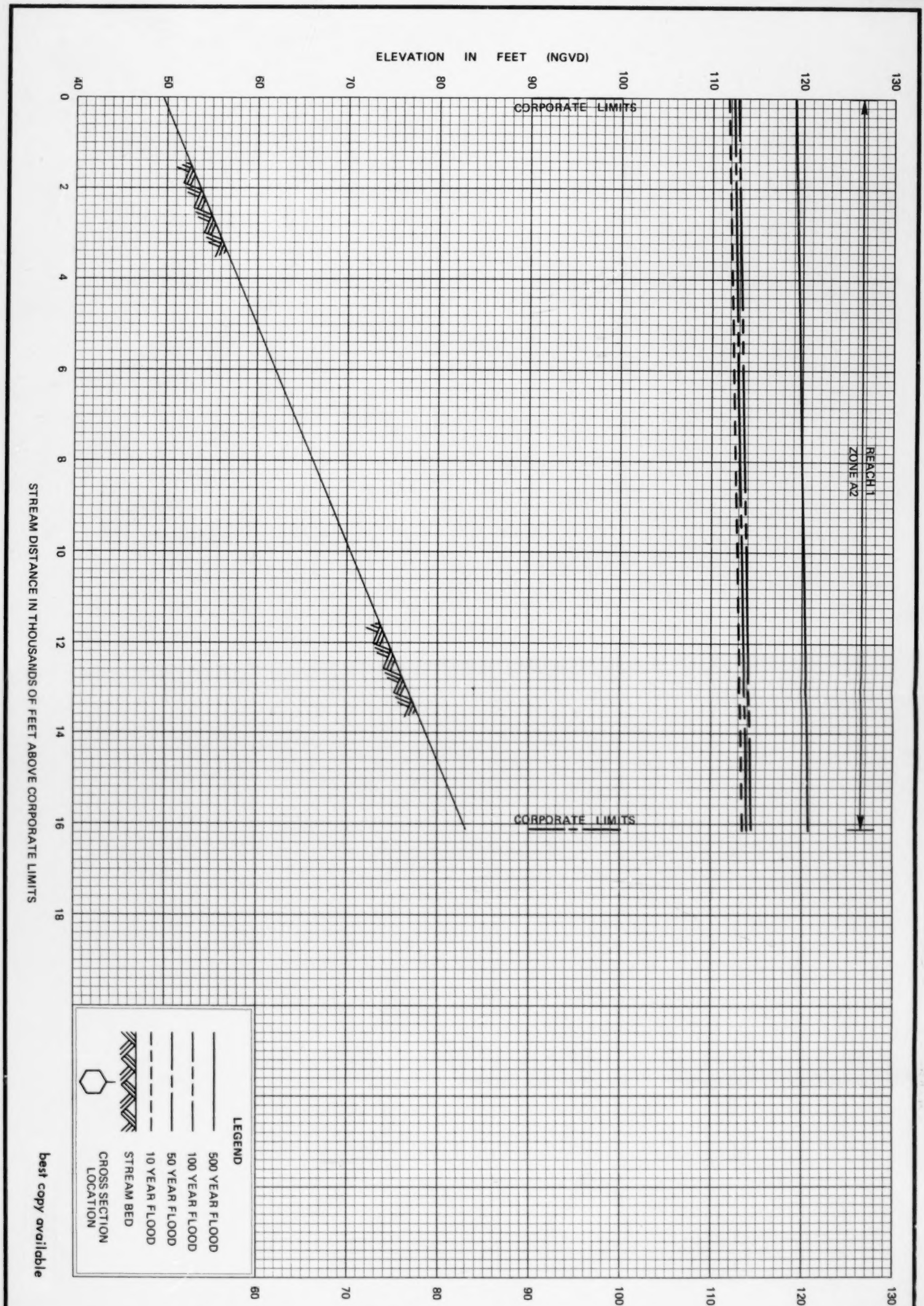
8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Drumore, Lancaster County, Pennsylvania (Unpublished).

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of East Drumore, Lancaster County, Pennsylvania (Unpublished).

10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Little Britain, Lancaster County, Pennsylvania (Unpublished).

U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Holtwood, Pennsylvania, 1955, Photorevised 1969; Wakefield, Pennsylvania, 1955, Photorevised 1969; Conowingo Dam, Pennsylvania-Maryland, 1953, Photorevised 1970; Delta, Pennsylvania-Maryland, 1956, Photorevised 1974; Rising-Sun, Pennsylvania-Maryland, 1953, Photorevised 1970.



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FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF FULTON, PA
(LANCASTER CO.)

FLOOD PROFILES

SUSQUEHANNA RIVER